

AbstractID: 5138 Title: A new formula for normal tissue complication (NTCP) as a function of equivalent uniform dose (EUD) in the Lyman-Kutcher-Burman (LKB) model

Purpose: Use of biological outcome predictions in treatment planning represents a potential improvement over purely dose-based planning. To promote increased use of outcome predictions, a mathematical tool is developed for the widely-used Lyman phenomenological model of normal tissue complication probability (NTCP).

Method and Materials: A simpler-appearing formula that accurately approximates the Lyman model for NTCP is introduced. The new equation for NTCP as a function of the equivalent uniform dose (EUD) is similar to the LQ formula for single-fraction single-cell survival.

Results: To within 0.2%, the Lyman formula for a uniformly irradiated OAR is given by an analytical representation similar to the LQ formula for single-fraction cell survival, with tissue parameters derived from those in the Lyman formula. The formula differs from that of the LQ model for cell kill in that the parameter corresponding to the α/β ratio is negative. Simple equations are given to calculate formula parameters from m and TD_{50} for organs at risk (OARs) in the Lyman model. Likewise, equations are given for calculating m and TD_{50} from parameters in the new formulae. The role of the volume-effect parameter n is not changed from the Lyman model, and is used to calculate EUD for non-uniformly irradiated OARs based on the Kutcher-Burman (K-B) reduction algorithm. A table of parameter values is presented derived from published Lyman parameter fits to the Emami compilation of normal tissue complications.

Conclusion: New linear-quadratic type formulae are shown to be useful in depicting the results of the LKB model for NTCP for inhomogeneously-irradiated OARs.

Transformation formulae are given for the LQ-NTCP parameters in terms of the Lyman parameters m and TD_{50} , and tables of LQ-NTCP parameters are given, based on published Lyman model fits to various OARs. An equation is given for the EUD corresponding to pre-selected levels of NTCP.